PROJECT CONSORTIUM

The consortium of the joint project LiSA consists of eight partners from research and industry that have contributed their expertise in various fields to the project and developed new systems and components. The project partners are:

- Fraunhofer IFF, Magdeburg (project coordinator)
- University of Osnabrück, Institut für Informatik, AG Wissensbasierte Systeme, Osnabrück
- Jenoptik Laser, Optik, Systeme GmbH, Jena
- Sympalog Voice Solutions GmbH, Erlangen
- SCHUNK GmbH & Co. KG, Lauffen/Neckar
- Götting KG, Lehrte
- [project:syntropy] GmbH, Magdeburg
- KeyNeurotek AG, Magdeburg

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BETREUT VOM

Projektträger
Forschungszentrum
Karlsruhe (PTKA)

For more information on the LiSA project, visit www.lisa-roboter.de.

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LISA: ASSISTANT ROBOT IN LIFE SCIENCE COMPANY LABS

THE LISA PROJECT

Long banished behind steel barriers, robots are increasingly being implemented as service robots and assistance systems in direct proximity to humans. Fields of application have long ceased to be limited to industrial manufacturing. Applications in lab automation, medical technology and private households are making robots universally implementable systems.

New innovations are allowing humans and robots to cooperate and are blurring the boundaries of workspaces. Aspects such as safe direct human-robot interaction, a system's cognitive skills and simple operation and multimodal interaction are becoming priorities

Funded by the Federal Ministry of Education and Research (BMBF) in its program Key Innovations: Service Robots, the project Assistant Robot in Life Science Company Labs LiSA has taken up the latest findings from robot research, sensor systems and computer science and combined them in a demonstration system. Special emphasis was placed on the safety of mobile systems and manipulators, navigation in dynamic environments, optical object recognition and multimodal interaction.

LISA, short for Life Science Assistant, is a service robot designed for use in biotechnology labs. It relieves lab technicians of routine tasks and facilitates twenty-four hour operation of variable test sequences. Naturally, the system is also implementable in manufacturing, households and public domains with minor modifications.

LiSA

ASSISTANCE ROBOT IN LIFE SCIENCE COMPANY LABS

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PROJECT OBJECTIVE

The objective of the LiSA project was the development, construction and testing of a mobile assistant robot suitable for everyday use, which interacts with staff in life science company labs and independently takes over routine tasks such as transporting multiplates and loading stations. Flexibility, intuitive operation and safety are crucial to the acceptance of an assistant robot that shares a work environment and interacts with human workers.

ROBOTER SYSTEM COMPONENTS

Various components were developed and assembled in a demonstrator during the LiSA project's three-year runtime. The developed robot system was tested in a life science company's lab under real conditions.

Mobile Platform

The LISA robot's mobile platform has an omnidirectional drive that enables it to navigate reliably in a lab's frequently cramped conditions. This enables the robot to approach tables laterally without complex maneuvering. The platform is equipped with six laser scanner that form a protective cone around the robot. Switching strips mounted close to the floor additionally reliably detect collisions to protect humans and inventory.

Navigation System

LISA determines its position with the aid of two horizontally mounted laser scanners. The novel arrangement of another four scanners aligned upward at a 60° angle additionally provides three-dimensional sensor data. Thus, the robot is even able to detect obstacles like open drawers and cupboard doors and avoid them.

Speed and mode of operation are dynamically adapted to the situation of the environment to pass through doors at reduced speed for instance.

Manipulator

A robotic arm with four degrees of freedom is located on the mobile platform. Its kinematics was developed to handle standardized objects in the life science sector (multiplates). A two-finger gripper enables LISA to pick up multiplates, take off and put back on covers and load lab equipment. Humans and robots use marked transfer areas on lab tables or the robot itself to exchange multiplates.

Object Recognition

A stereo camera system that detects objects and determines their position is located above the gripper at the end of the second segment of the robotic arm. Optical triangulation is used to exactly scan lab equipment, storage positions and even transparent multiplates and guide the gripper to the desired position.

A tilting infrared camera mounted at the base of the manipulators is constantly aimed at the gripper. When human interaction in the work area is detected through body heat, the manipulator is stopped to be safe.

Multimodal Interaction

The robot is operated and jobs are issued through a graphic user interface and natural language. To this end, every user is outfitted with a tablet PC and a headset. These two input modalities can be separated from one another or also used in combination. Thus input in the form of "take the multiplate from here to there" is possible, the words "here" and "there" being accompanied by touching an interactive map. When the input is incomplete, the system specifically requests the missing information.

Artificial Skin Safety Component

The LISA robot operates in humans' direct environment. They both move in the shared workspace and may also come into contact. Thus, the safety of humans is a crucial aspect.

In addition to other safety functions, the heart of the safety concept is a new patent pending planar tactile sensor system developed by the Fraunhofer IFF, which measures contact locally and force resolved. Both the mobile platform and the manipulator are covered with this artificial skin, which enables controlling and reliably stopping the robot when a collision occurs. The cushioning zones integrated in the sensor system absorb impacts and additionally serve as bumpers.